



*Better Buildings Residential Network
Peer Exchange Call Series*

*The Latest on Windows:
Thin Triples and Other Advances in Efficiency*

February 25, 2021

Agenda and Ground Rules

- Agenda Review and Ground Rules
- Opening Poll
- Residential Network Overview and Upcoming Call Schedule
- Featured Speakers
 - **Robert Hart**, Lawrence Berkeley National Laboratory (LBNL)
 - **Elaine Miller**, Northwest Energy Efficiency Alliance (NEEA)
 - **Brad Begin**, Alpen High Performance Products
 - **Joe Wegele**, Renewal by Andersen
- Open Discussion
- Closing Poll and Announcements

Ground Rules:

1. **Sales of services and commercial messages are not appropriate** during Peer Exchange Calls.
2. Calls are a safe place for discussion; **please do not attribute information to individuals** on the call.

The views expressed by speakers are their own, and do not reflect those of the Dept. of Energy.

Better Buildings Residential Network

Join the Network

Member Benefits:

- Recognition in media and publications
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- One-on-One brainstorming conversations

Commitment:

- Members only need to provide *one number*: their organization's number of residential energy upgrades per year, or equivalent.

Upcoming Calls (2nd & 4th Thursdays):

- Mar 11: *Carrying the Load: What Is the State of Load Flexibility and Energy Efficiency?*
- Mar 25: *Smart Range Hoods vs. Indoor Air Quality: Coming to Kitchens Near You Soon*
- Apr 08: *Automation: Where is the Balance between Humans and Machines to Save Energy?*

Peer Exchange Call summaries are posted on the Better Buildings [website](#) a few weeks after the call

For more information or to join, for no cost, email bbresidentialnetwork@ee.doe.gov, or go to energy.gov/eere/bbrn & click Join



Robert Hart
Lawrence Berkeley National Laboratory
(LBNL)



Innovative Market Pathways to Promote Adoption of High-Performance Insulating Windows

Robert Hart
Building Technology & Urban Systems Division
Lawrence Berkeley National Laboratory

Content Outline

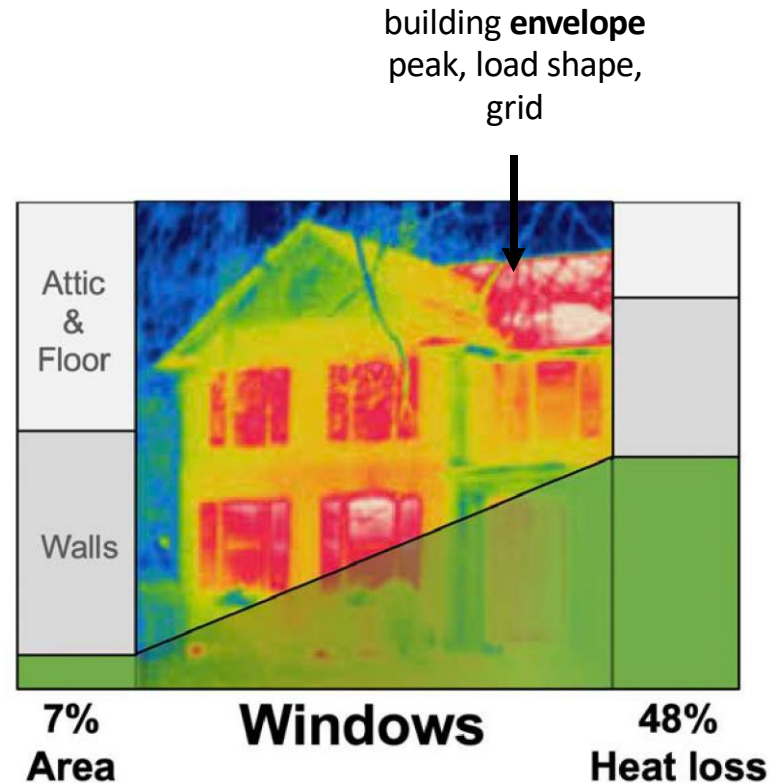
- Why are we interested in high-performance windows?
- Technology developments
- Technology demonstrations
- Driving market adoption

Windows in the Building Envelope

\$25 Billion per year



100%



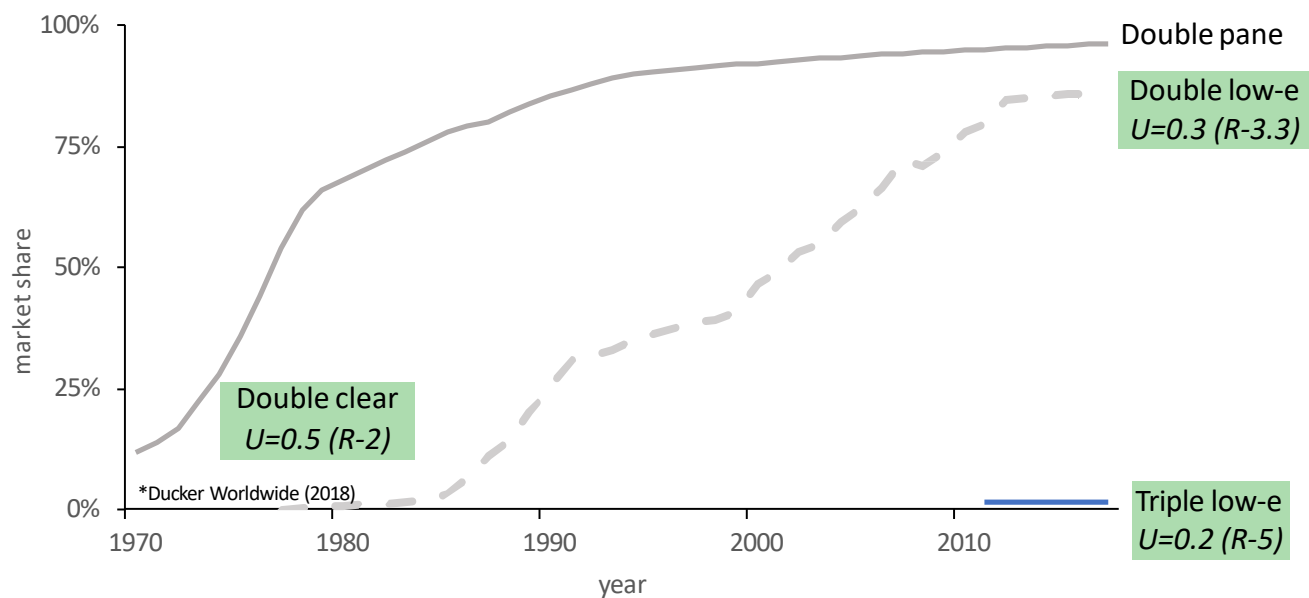
*Apte, J., Arasteh, D., Huang, Y.J. (2003) Future Advanced Windows for Zero-Energy Homes. ASHTRAE Transactions. LBNL-51913

**Based on 2,000 sf 2-story house, IECC 2015

A World Without Windows

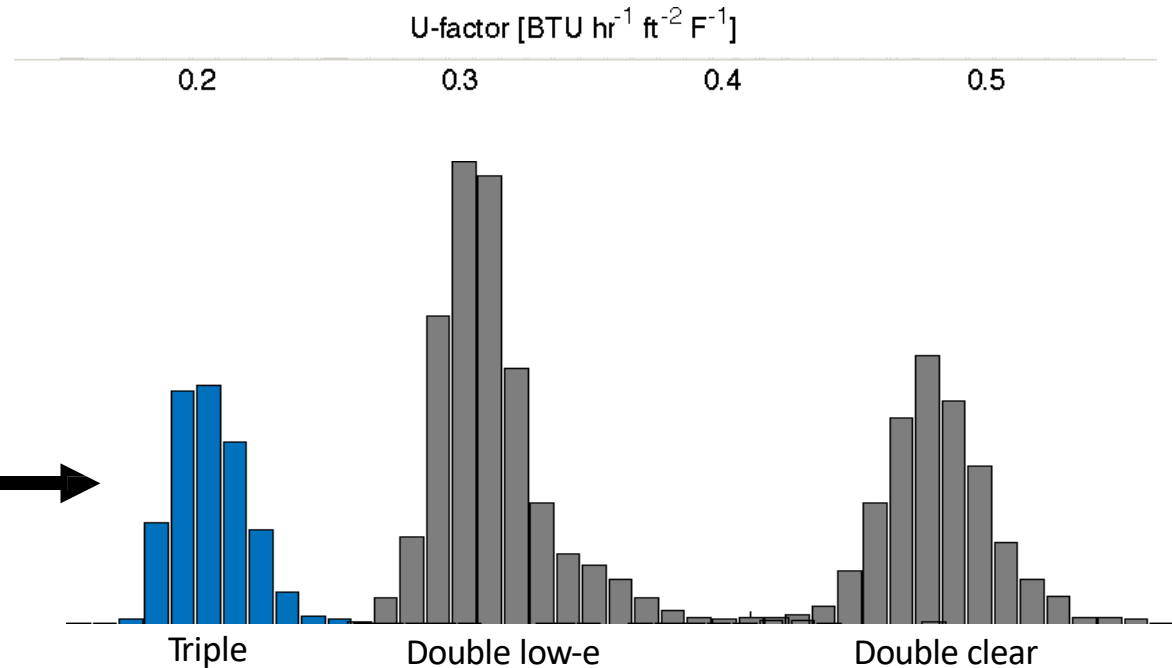


History of Window Market Share



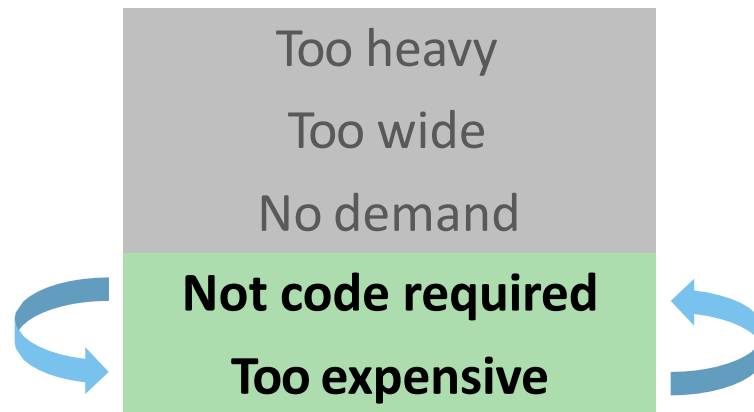
Why Not Traditional Triple-Pane?

We can make
high performance
windows now!



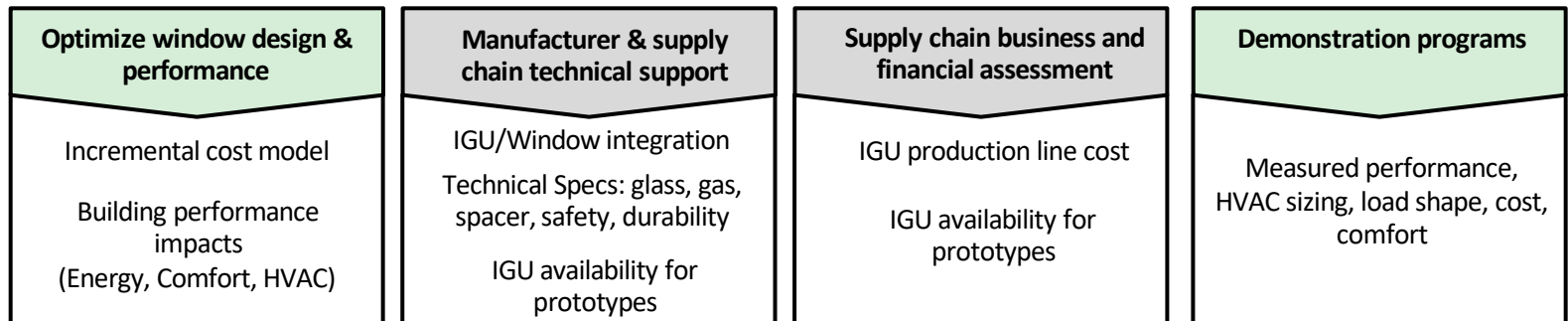
**NFRC CPD frequency Vertical Slider (2015)*

Why Not Traditional Triple-Pane?



Market Transformation

Can We Break the Cycle?



Technology Developments



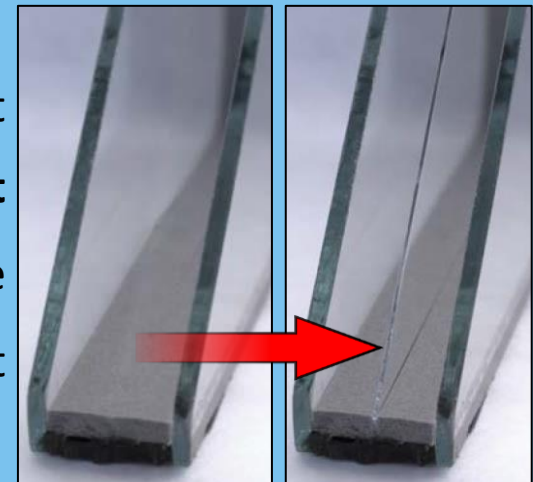
Thin-Triple Window Development



too **heavy**
too **wide**
too **expensive**
long ROI



Drop-in replacement
low entry **cost**
double performance
minimal weight

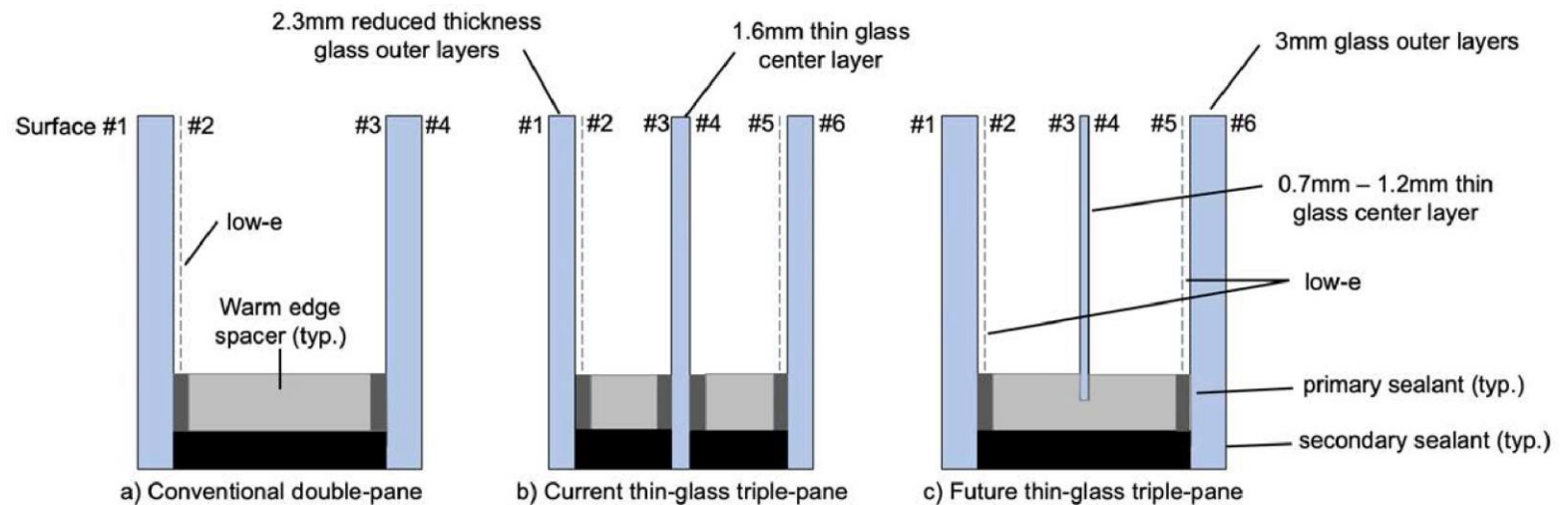


Double-pane

Thin-triple

Where Thin-Triple is Today

Design



Where Thin-Triple is Today

A selection of collaborators



CORNING



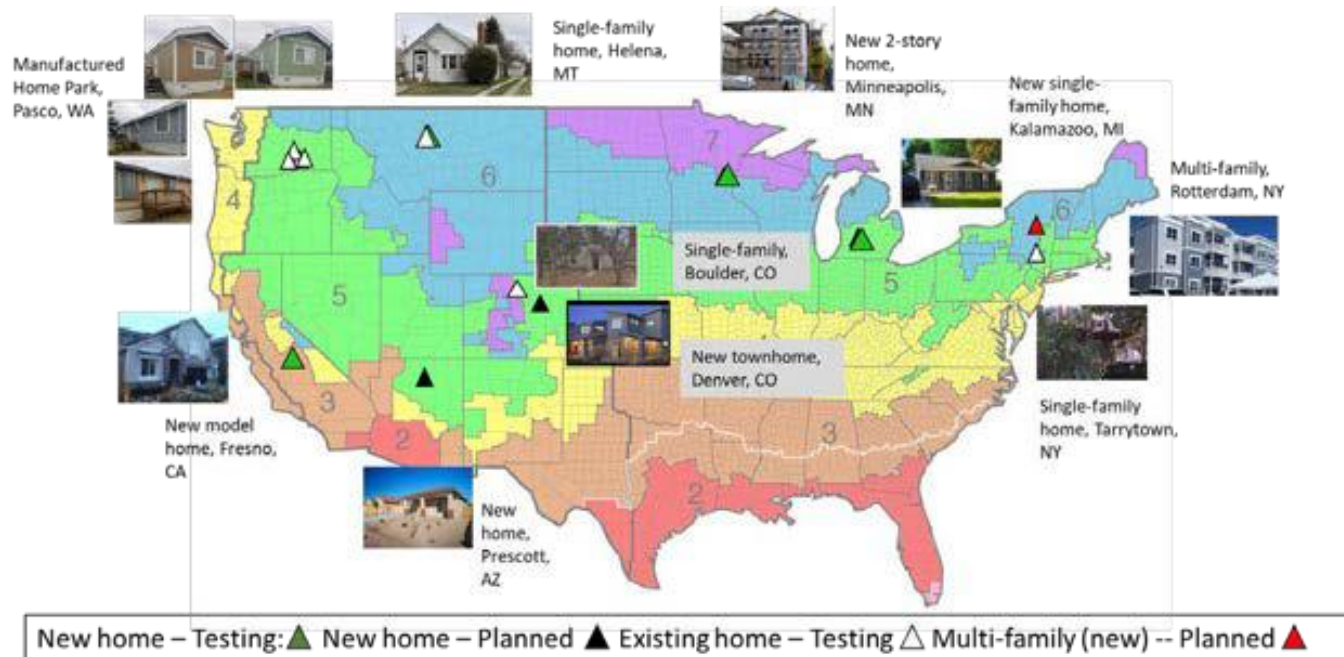
Technology Demonstrations



Demonstrations: Experimental Questions

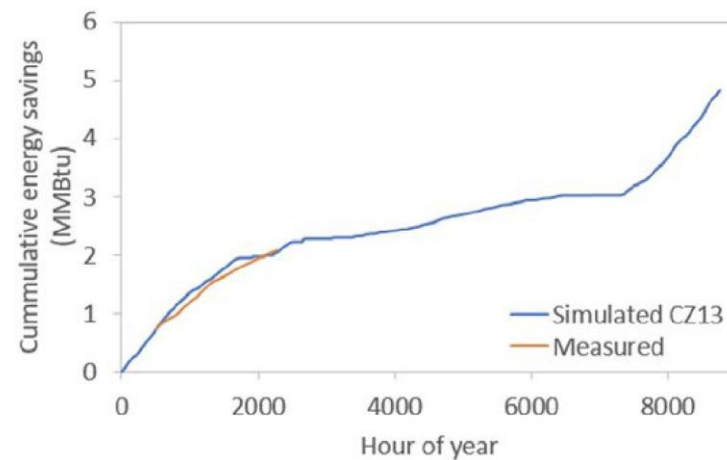
Experimental Questions/Topics	Validation Study Approach
Is thin-triple cost-effective for new construction and/or retrofit applications?	Life-cycle analyses through field testing and energy simulation
Is thin-triple “drop-in” replacement feasible	Demonstrations combine Alpen IGUs with multiple vendors’ frames and sashes
Does thin-triple-pane facilitate design flexibility in high-efficiency homes?	Demonstrations in multiple housing types
Does thin-triple allow for cost-effective system sizing trade-offs	Quantify system sizing implications using standard and mini-split heat pumps.
What co-benefits are associated with the installation of thin-triple windows?	Characterize comfort, condensation, and noise benefits.
Could thin-triple windows support the tightening of energy-rating standards?	Technical assistance to NFRC, PHIUS, and ENERGY STAR Most Efficient. Assess the impact of tightening restrictions and building energy codes.

Demonstrations: Planned & In Progress



Demonstrations: Preliminary Results

Fresno, Ca example



**Simulation with 2016 CBECC-RES*

Demonstrations: CEC GFO 19-307

Advanced Envelope Technologies



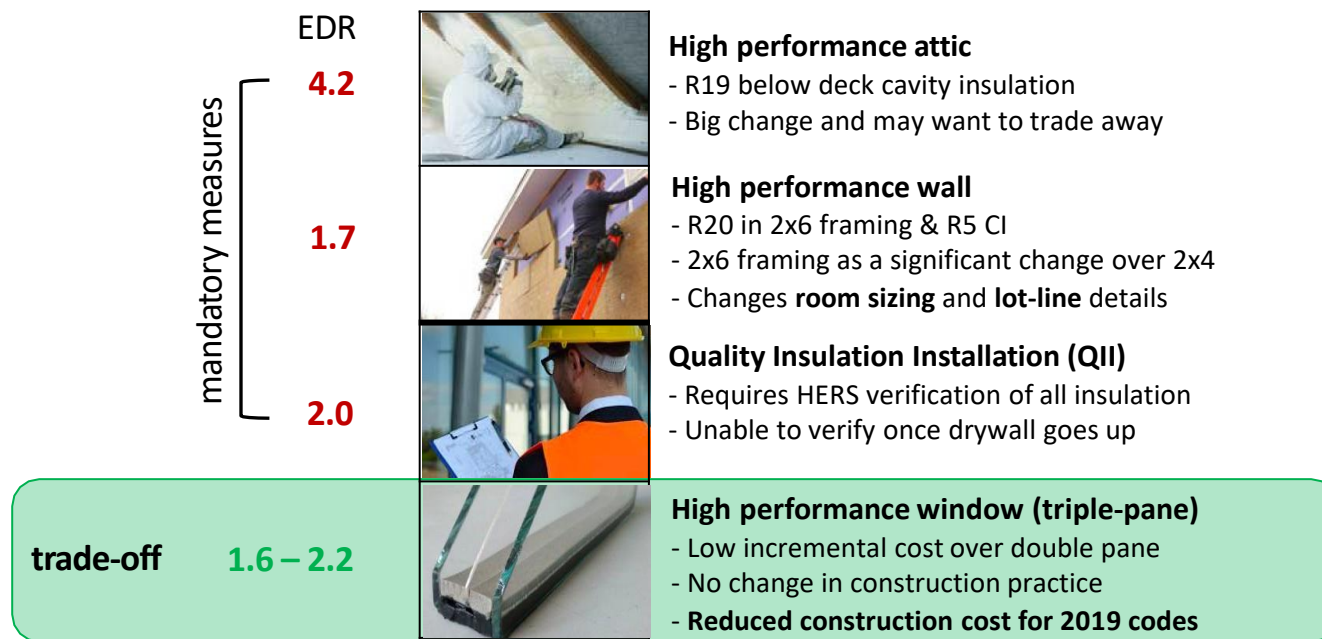
"Testing and **demonstrating** new building envelope measures with the goal of **reducing costs** and **increasing** energy **performance** for **retrofits** to existing low-rise **multifamily** and **single-family** residential buildings..."

Driving Market Adoption



Adoption Through Code Compliance

California Example

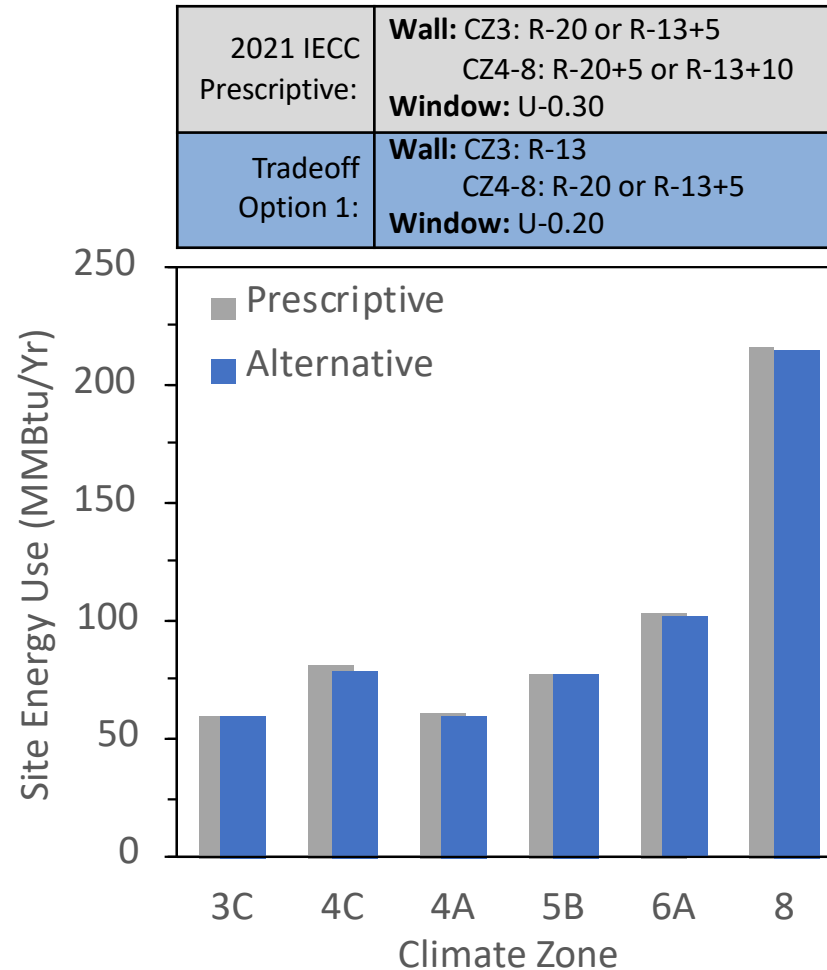


*2019 California Building Energy Efficiency Standards – Title 24

Adoption Through Code Compliance

National Approach

The window wall-trade-off works in CZ-3 and above!

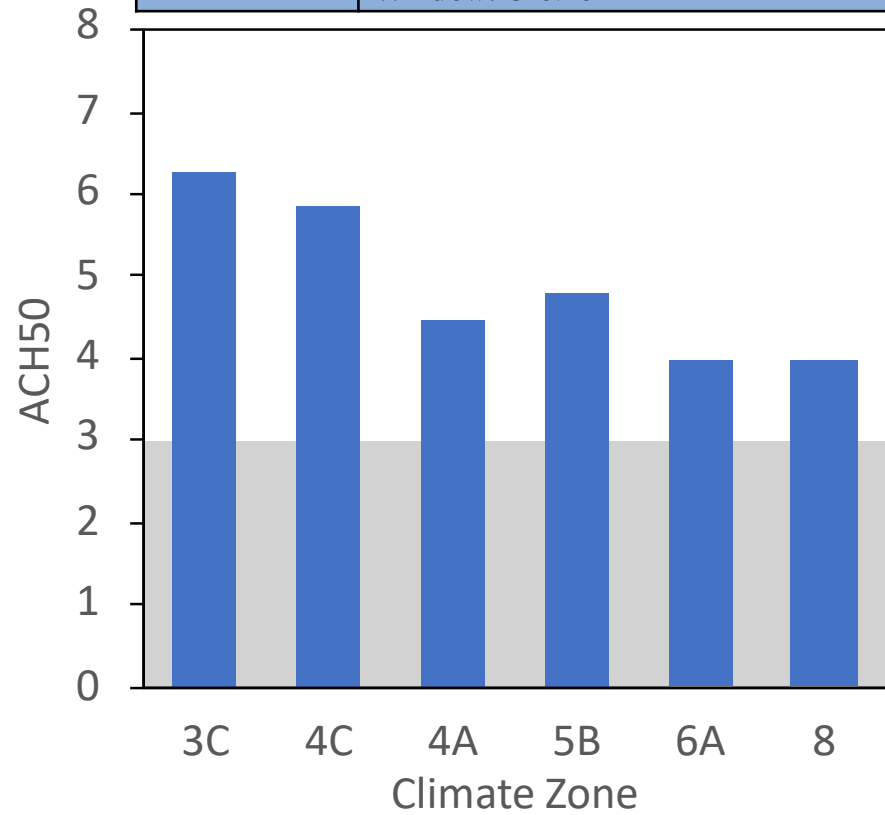


Adoption Through Code Compliance

National Approach

Other tradeoffs are
effective also

2021 Prescriptive:	Air Infiltration: 3 ACH50 Window: U-0.30
Tradeoff Option 2:	Air Infiltration: Maximum allowable for equal energy use Window: U-0.20



Innovative Market Pathways to Promote Adoption of High-Performance Insulating Windows

Engage

Robert Hart

RGHart@lbl.gov

Lawrence Berkeley National Laboratory

<https://windows.lbl.gov/high-performance-windows>





Elaine Miller
Northwest Energy Efficiency Alliance



BBRN Peer Exchange: Building Momentum for Thin Triples

Elaine Miller

Market Transformation Manager for Building Envelope Northwest Energy Efficiency Alliance

February 25, 2021





To Cover

- Who is NEEA?
- Current drivers in the Windows market
- A Market Transformation approach ripe for the market
 - create scale, leverage current forces/partners and build national momentum





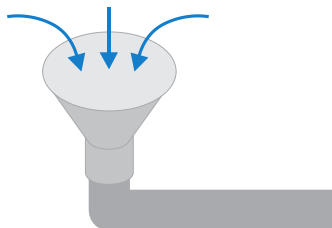
The Alliance





Accelerating Energy Efficiency

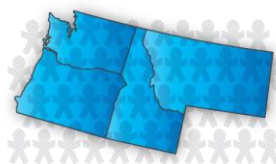
Fill the Energy
Efficiency
Pipeline



Accelerate
Market
Adoption



Leverage the
Power of the
Region



Create
greater scale
with National
Collaboration





Top 10 drivers in the market

- **Long measure life**, lost opportunity
- Essential tool to reach decarbonization goals
- **Product is commercially available** with several national players engaged
- **Technology is ready** for mass production
- With lighting savings waning, **utilities looking for new opportunities**
- Opportunity to **leverage production builders** through New Construction programs
- Technology is **drop in replacement**
- Opportunity to influence **ENERGY STAR spec**, (Canada is already there)
- Opportunity to **leverage existing national retailer** programs
- Opportunity to align large regions to ensure **greater engagement from manufacturers**

MAY 21, 2019

CEC Promotes "Skinny" Triple Glazed Windows as Solution to Title 24's Challenge



The California Energy Commission (CEC) is seeking to improve energy efficiency through alternate products such as the Thin Triple window. During the AAMA Western Region Summit, Payam Bozorchami with the CEC discussed an important element of the 2019 California Energy Standard - the energy design rating (EDR) metric.



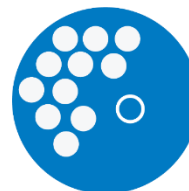
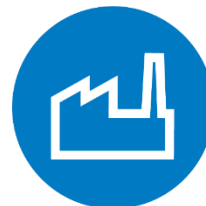
RENEWAL
by **ANDERSEN**
FULL-SERVICE WINDOW & DOOR REPLACEMENT





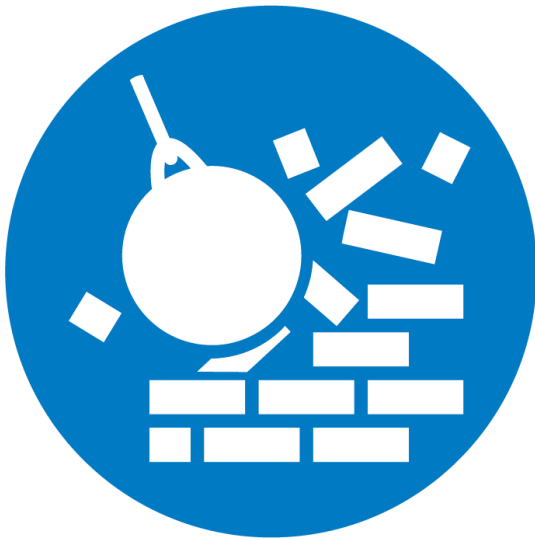
Has all the elements of a MT Approach

- Engaged manufacturers with a product that is commercially available
- A few large players that could have a large impact
- Some existing programmatic channels to leverage
- Market differentiation tool – Energy Star
- Opportunity for incentives
- A clear benefits case





But... Barriers to Address



- Cost
- Lack of manufacturer business case for retooling and volume production
- Consumer lack of awareness
- Builder / installer lack of awareness
- Customer and builder concern about product cost, performance



Launch a National Collaborative

- Partnership for Advanced Window Solutions – PAWS
- Goal: Through collaborative research and programs, PAWS aims to aggregate market demand, reduce product cost, quantify benefits, accelerating the adoption of advanced windows.
- Strategies:
 - Promote R5+ window business case to volume builders across territories – **aggregate demand**
 - Engage manufactures to supply volume builders via pooled resources – **share initial costs of retooling plants**
 - Engage large utilities to provide incentives for .20 U windows – **lower cost to consumers** and build awareness
 - **Build awareness** through marketing partnerships between manufacturers, utilities and others
 - Engage national PAW members to actively **promote ENERGY STAR** change to R5+

Create greater
scale with
National
Collaboration





Partners

- Public interest agencies
- Efficiency advocates
- Government entities- state, national
- Utilities
- Research Organizations
- Standards and Rating Organizations



Desired End State

TTWs are preferred
option for existing
building retrofits

TTWs are business as
usual in new
construction

Market share of U = .20
ENERGY STAR windows
50%+

State Codes require
 $U \leq 0.20$

Windows reach .15 -
Cut energy
consumption by
windows in 1/2



Elaine Miller

Market Transformation Manager, Building Envelope

503-490-9877, emiller@neea.org



NW Natural®

PACIFIC POWER





Brad Begin
Alpen High Performance Products

The Latest on Windows: Thin Triples (and Quads) And Other Advances in Energy Efficiency

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Who is Alpen High Performance Products



Lightweight High Performance Window and Glass Expertise

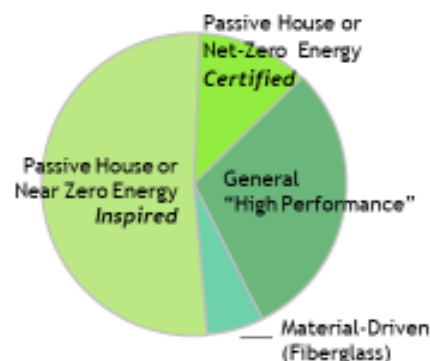
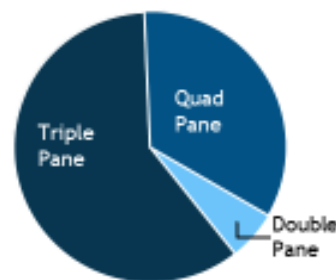
- 40 years working with suspended coated films in insulated glass manufacturing and windows
- 50% residential and 50% commercial

Window and Door Products

- North American style fiberglass product – Zenith Series
- European style hybrid fiber-reinforced uPVC product line –Tyrol Series
- Up to full frame R10 *NFRC-certified* products

Organizational History of Innovating

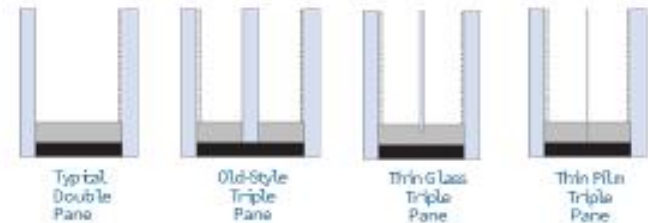
Introduced to Thin Glass through DOE contacts in 2018



What is “Thin Glass”?

To Alpen, ‘thin glass’ is .7mm to 1.3mm thick glass

- 3-4x thinner than typical residential glass
- 6-8x thinner than typical commercial glass

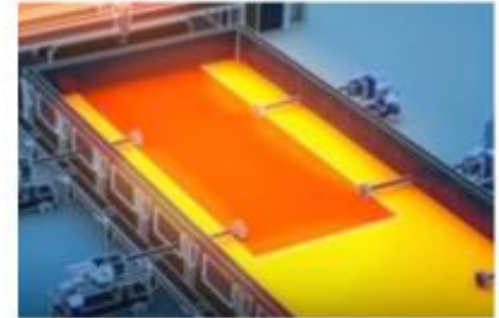


Made one of two ways:

- Vertical Cast
- Horizontal Float

Considerations:

- Tempering
- Access to Low Emissivity



Advantage of Thin Glass: VERY LIGHT WEIGHT

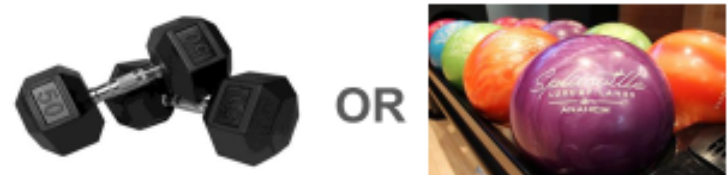


20 SQ/FT WINDOW **WEIGHT DIFFERENCE** TO MAKE A TRIPLE IN PLACE OF A DOUBLE
BASED ONLY ON CHANGE IN CENTER PANE LITE



Added weight = approximate weight of
two apple pies

6.6 pounds



Added weight = approximate weight of
two 25 pound dumbbells or 5 bowling balls

48 pounds

Alpen's Experience to Date with Thin Glass

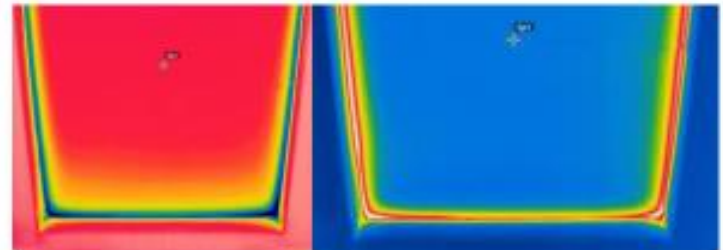
Two major organizational biases – “difficult to work with” **WRONG** and “fragile or easy to break ” **WRONG**

PUTTING IN THE WORK TO VALIDATE:

- Lab testing
 - Thermal stress testing **PASS**
 - Physical durability Testing **PASS**
 - Reflectivity, visible distortion and visual performance **PASS**
 - Manufacturability validation
 - Handling, cutting, drilling, spacer application **FIGURED OUT – EXCELLENT**
 - Customer/market facing feedback **ALL POSITIVE WITHOUT EXCEPTION**
 - Supply channel work **SOLID AND RELIABLE**
 - Field installations **NUMEROUS AND NO SURPRISES**
 - Product certification work **COMPLETED**
-

Alpen “Thin Glass” Testing Examples

- Simulated steadily rising alternating negative and positive pressure to destruction with 50 square foot thin glass triple
 - Quarter inch annealed outer lites and 1 mm center lite
 - Failure at simulated 240 mph (thin glass last to break)
 - Super fun to break stuff on purpose
- Thermal stress shock testing with LBNL with extremely rapid cycling between up to 160+ degree outside temperature deltas with steady inside temperature





Alpen's Experience to Date with Thin Glass

Unexpected Pleasant Surprises

- Potential IG Durability Improvement
 - **Non-structural.** Thin glass not structural so doesn't create require glass goes to edge of IG combination
 - **More flexible.** Thin glass is less rigid and more flexible so can withstand greater stresses (.7mm glass is 79 times more flexible than 3mm glass)
 - **Innovative Warm Edge Spacer.** Creates new spacer opportunities for uniquely designed grooved spacers with fewer air and water permeation paths and other innovations aiding whole window performance as well
 - Have made units with eight different high performance spacer combinations and getting excellent results
 - **Less edge damage.** Less edge area of glass leads to less opportunity for edge damage and stress cracks
- Far Lower Embodied Energy
 - Thin glass use of energy is almost directly proportionately reducing use of energy to make the glass
- New Product Innovations Outside of original intended use as IG center lite like the exciting **WinSert Product Line**

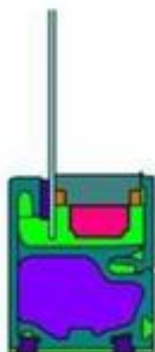
WinSert Lite and WinSert Plus

Secondary Window Insert

Better *thermal performance* and *lighter, faster, easier and less expensive* to install



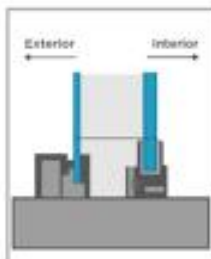
WINSERT LITE



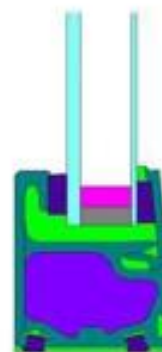
Super Insulated, Low Profile Fiberglass Frame

Thin Glass and Performance Safety Film

3X Lighter Than Other Solutions

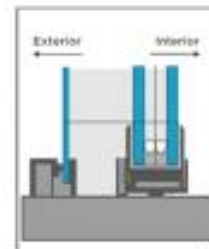


WINSERT PLUS



Same as WinSert Lite, but Using Micro Insulated Glass Unit with Thin Glass

2X Lighter Than Other Solutions



GSA Green Proving Ground Program Reports (95% complete stage)



ONE REPORT ON WINSERT



ONE REPORT ON THIN GLASS QUAD PANE WINDOWS





Joe Wegele
Renewal by Andersen



Renewal by Andersen ® Enhanced Triple Pane Glass

Joe Wegele

Director of Product Management

Drew Pavlacky

Glass and Glazing Technical Lead

2/26/2021

Renewal by Andersen® Enhanced Triple Pane Glass



Select Renewal by Andersen® windows with Enhanced Triple Pane glass have been recognized as ENERGY STAR® Most Efficient for 2021



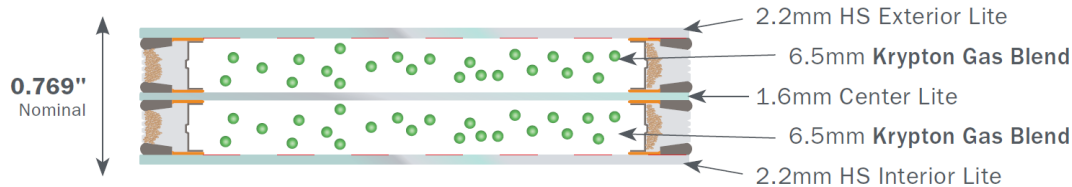
Renewal by Andersen® Enhanced Triple Pane Glass

Homeowners planning to replace windows

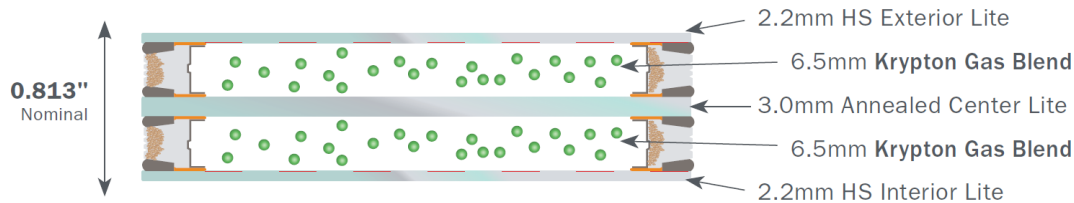


Renewal by Andersen® Enhanced Triple Pane Glass

Double-Hung (DG), Gliding, Casement, Fixed, and Awning glass construction:



Universal Picture Window and Universal Specialty Window glass construction:



Contributors to Higher Price

- Krypton Gas Blend Fill
- Two Spacers
- Uncommon Window Glass

Renewal by Andersen® Enhanced Triple Pane Glass

Current Limitations

- Limited Available Sizes
- Fewer Pattern Options
- Reduced Grille Offering
- No Laminated or Tempered Construction for Code Requirements
- Geographic Constraints – Breather tubes not currently available
- Aesthetic Drawback: Venting Hole

Renewal by Andersen® Enhanced Triple Pane Glass

Maximum Adoption

Reduce Current Limitations

- Limited Available Sizes
- Fewer Pattern Options
- Reduced Grille Offering
- Tempered

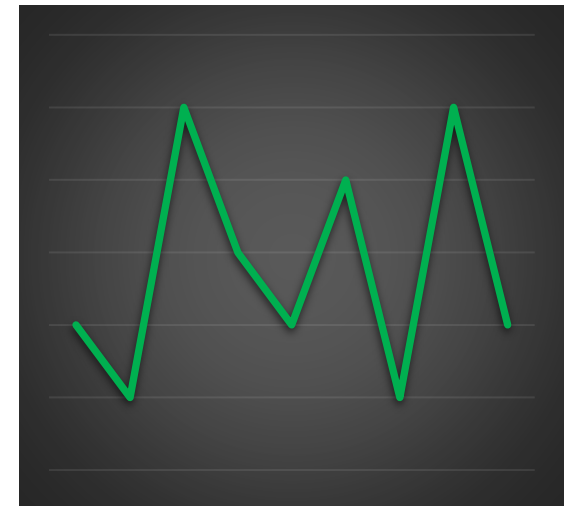
Economies of Scale

Lower Cost



Higher Volume

Stable Krypton Gas Cost



Closing Poll

- **After today's call, what will you do?**
 - Consider implementing one or more of the ideas discussed
 - Seek out additional information on one or more of the ideas
 - Make no changes to your current approach
 - Other (please explain)

New Virtual Sessions from Solar Decathlon on Innovative Homes and Energy Careers

The Solar Decathlon announced a new webinar series starting in September that will include virtual tours of innovatively designed homes and address a variety of topics from the rise in zero energy homes to clean energy careers.



U.S. DEPARTMENT OF ENERGY

SOLAR DECATHLON

Upcoming DOE Solar Decathlon Virtual Sessions

Register for Upcoming Sessions and Watch Prior Sessions at solardecathlon.gov/virtual_sessions.html

- **The Future of Solar: A Tour of Cutting-Edge Solar Research with the U.S. Department of Energy**
Wednesday, March 17, 2021, 1–2 p.m. E.T.
- **Winning Solar Home - The DOE Solar Decathlon Build Challenge Winners**
Wednesday, April 28, 2021, 1–2 p.m. E.T.



STEM RISING

U.S. DEPARTMENT OF ENERGY
[ENERGY.GOV/STEMRISING](https://www.energy.gov/stemrising)

Explore the Residential Program Solution Center

Resources to help improve your program and reach energy efficiency targets:

- [Handbooks](#) - explain *why* and *how* to implement specific stages of a program.
- [Quick Answers](#) - provide answers and resources for common questions.
- [Proven Practices](#) posts - include lessons learned, examples, and helpful tips from successful programs.
- [Technology Solutions](#) **NEW!** - present resources on advanced technologies, **HVAC & Heat Pump Water Heaters**, including installation guidance, marketing strategies, & potential savings.



<https://rpssc.energy.gov>

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or future call topic ideas to:
bbresidentialnetwork@ee.doe.gov